# CLAIMS

What is claimed is:

1. An ultrasonic medical device comprising:

an ultrasonic probe comprising a proximal end, a distal end and a longitudinal axis therebetween;

a transducer creating a torsional vibration of the ultrasonic probe;

a coupling engaging the proximal end of the ultrasonic probe to a distal end of the transducer; and

an ultrasonic energy source engaged to the transducer that produces an ultrasonic energy,

wherein an active area of the ultrasonic probe supports the torsional vibration and a transverse vibration.

2. The ultrasonic medical device of claim 1 wherein the torsional vibration induces the transverse vibration along the active area of the ultrasonic probe.

3. The ultrasonic medical device of claim 1 wherein the active area is at least a portion of the longitudinal axis of the ultrasonic probe.

4. The ultrasonic medical device of claim 1 wherein tension to the ultrasonic probe tunes the transverse vibration into coincidence with the torsional vibration.

5. The ultrasonic medical device of claim 1 wherein bending the ultrasonic probe tunes the transverse vibration into coincidence with the torsional vibration.

6. The ultrasonic medical device of claim 1 wherein bending the ultrasonic probe shifts a frequency of the ultrasonic probe causing the transverse vibration to coincide with the torsional vibration.

7. The ultrasonic medical device of claim 1 wherein the torsional vibration and the transverse vibration are superimposed over the active area of the ultrasonic probe.

8. The ultrasonic medical device of claim 1 wherein the torsional vibration and the transverse vibration are segregated over the active area of the ultrasonic probe.

9. The ultrasonic medical device of claim 1 wherein the torsional vibration of the ultrasonic probe produces a plurality of torsional nodes and a plurality of torsional anti-nodes along at least the active area of the ultrasonic probe.

10. The ultrasonic medical device of claim 1 wherein the torsional vibration of the ultrasonic probe causes a rotation and counterrotation along at least the active area of the ultrasonic probe.

11. The ultrasonic medical device of claim 1 wherein the torsional vibration of the ultrasonic probe is propagated in a forward direction and a reverse direction about a plurality of nodes along at least the active area of the ultrasonic probe.

12. The ultrasonic medical device of claim 1 wherein the torsional vibration and the transverse vibration generate acoustic energy in a medium surrounding the ultrasonic probe through an interaction of a surface of the ultrasonic probe and the medium surrounding the ultrasonic probe.

13. The ultrasonic medical device of claim 1 wherein the transverse vibration of the ultrasonic probe produces a plurality of transverse nodes and a plurality of transverse anti-nodes along at least the active area of the ultrasonic probe.

14. The ultrasonic medical device of claim 1 wherein the torsional vibration generates acoustic energy in a medium surrounding the ultrasonic probe.

15. The ultrasonic medical device of claim 1 wherein the transverse vibration generates acoustic energy in a medium surrounding the ultrasonic probe.

16. The ultrasonic medical device of claim 1 wherein the ultrasonic energy source delivers ultrasonic energy in a frequency range from about 10 kHz to about 100 kHz.

17. The ultrasonic medical device of claim 1 wherein the ultrasonic energy source determines a resonant frequency of the transducer and provides an electrical power to the transducer at the resonant frequency of the transducer.

18. The ultrasonic medical device of claim 1 wherein the ultrasonic probe has a flexibility allowing the ultrasonic probe to support the torsional vibration and the transverse vibration.

19. The ultrasonic medical device of claim 1 wherein the ultrasonic probe comprises an approximately circular cross section from the proximal end of the ultrasonic probe to the distal end of the ultrasonic probe.

20. The ultrasonic medical device of claim 1 wherein the ultrasonic probe comprises a varying diameter from the proximal end of the ultrasonic probe to the distal end of the ultrasonic probe.

21. The ultrasonic medical device of claim 1 wherein a portion of the longitudinal axis of the ultrasonic probe comprises a radially asymmetric cross section.

22. The ultrasonic medical device of claim 1 wherein the ultrasonic probe comprises a substantially uniform cross section from the proximal end of the ultrasonic probe to the distal end of the ultrasonic probe.

23. The ultrasonic medical device of claim 1 wherein the ultrasonic probe comprises a varying cross section from the proximal end of the ultrasonic probe to the distal end of the ultrasonic probe.

24. A medical device comprising:

an elongated, flexible probe comprising a proximal end, a distal end and a longitudinal axis between the proximal end and the distal end;

a transducer that converts electrical energy into mechanical energy creating a torsional vibration along the longitudinal axis of the elongated, flexible probe;

a coupling engaging the proximal end of the elongated, flexible probe to a distal end of the transducer; and

an ultrasonic energy source engaged to the transducer that provides the electrical energy to the transducer,

wherein the longitudinal axis of the elongated, flexible probe supports the torsional vibration and a transverse vibration.

25. The medical device of claim 24 wherein the torsional vibration induces the transverse vibration along the longitudinal axis of the elongated, flexible probe.

26. The medical device of claim 24 wherein at least a portion of the longitudinal axis of the elongated, flexible probe supports the torsional vibration and the transverse vibration.

27. The medical device of claim 24 wherein tension to the elongated, flexible probe tunes the transverse vibration into coincidence with the torsional vibration.

28. The medical device of claim 24 wherein the torsional vibration and the transverse vibration are superimposed over the longitudinal axis of the elongated, flexible probe.

29. The medical device of claim 24 wherein the torsional vibration and the transverse vibration are segregated over the longitudinal axis of the elongated, flexible probe.

30. The medical device of claim 24 wherein the elongated, flexible probe comprises a substantially uniform diameter from the proximal end of the elongated, flexible probe to the distal end of the elongated, flexible probe.

31. The medical device of claim 24 wherein the elongated, flexible probe comprises a varying diameter from the proximal end of the elongated, flexible probe to the distal end of the elongated, flexible probe.

32. The medical device of claim 24 wherein the elongated, flexible probe is disposable.

33. The medical device of claim 24 wherein the elongated, flexible probe is for a single use on a single patient.

34. A method of treating a biological material in a body with an ultrasonic medical device comprising:

providing the ultrasonic medical device comprising an ultrasonic probe having a proximal end, a distal end and a longitudinal axis therebetween;

moving the ultrasonic probe to a treatment site of the biological material to place the ultrasonic probe in communication with the biological material;

activating an ultrasonic energy source engaged to the ultrasonic probe to produce an ultrasonic energy that is converted into a torsional vibration of the ultrasonic probe; and

vibrating an active area of the ultrasonic probe.

35. The method of claim 34 wherein the torsional vibration of the ultrasonic probe induces a transverse vibration in the active area of the ultrasonic probe.

36. The method of claim 34 wherein the active area of the ultrasonic probe supports the torsional vibration and a transverse vibration.

37. The method of claim 34 further comprising tuning the transverse vibration into coincidence with the torsional vibration along the active area of the ultrasonic probe.

38. The method of claim 34 further comprising applying a tension to the ultrasonic probe to tune the transverse vibration into coincidence with the torsional vibration.

39. The method of claim 34 further comprising bending the ultrasonic probe to tune the transverse vibration into coincidence with the torsional vibration.

40. The method of claim 34 further comprising superimposing the torsional vibration and the transverse vibration over the active area of the ultrasonic probe.

41. The method of claim 34 further comprising segregating the torsional vibration and the transverse vibration over the active area of the ultrasonic probe.

42. The method of claim 34 further comprising creating the torsional vibration along at least the active area of the ultrasonic probe by a transducer engaging the ultrasonic energy source at a proximal end of the transducer and the ultrasonic probe at a distal end of the transducer.

43. The method of claim 34 further comprising generating acoustic energy in a medium surrounding the ultrasonic probe through an interaction of a surface of the ultrasonic probe and the medium surrounding the ultrasonic probe resulting from the torsional vibration and a transverse vibration.

44. The method of claim 34 further comprising producing a plurality of nodes and a plurality of anti-nodes along at least the active area of the longitudinal axis of the ultrasonic probe from the torsional vibration.

45. The method of claim 34 further comprising producing a plurality of transverse nodes and a plurality of transverse anti-nodes along at least the active area of the longitudinal axis of the ultrasonic probe from the transverse vibration.

46. The method of claim 34 further comprising producing a rotation and counterrotation of the ultrasonic probe along at least the active area of the ultrasonic probe.

47. The method of claim 34 further comprising projecting the torsional vibration in a forward direction and a reverse direction about a plurality of nodes of the ultrasonic probe.

48. The method of claim 34 further comprising sweeping the ultrasonic probe along the treatment site of the biological material.

49. The method of claim 34 further comprising moving the ultrasonic probe back and forth along the treatment site of the biological material.

50. The method of claim 34 further comprising rotating the ultrasonic probe along the treatment site of the biological material.

51. The method of claim 34 further comprising delivering ultrasonic energy in a frequency range from about 10 kHz to about 100 kHz by the ultrasonic energy source.

52. The method of claim 34 further comprising determining the resonant frequency of the transducer and providing an electrical power to the transducer at a resonant frequency of the transducer of the ultrasonic medical device.

53. The method of claim 34 further comprising providing the ultrasonic probe having a flexibility allowing the ultrasonic probe to support the torsional vibration and the transverse vibration.

54. The method of claim 34 wherein the active area is at least a portion of the longitudinal axis of the ultrasonic probe.

55. A method of removing a biological material in a body comprising:

providing an ultrasonic medical device comprising a flexible probe having a proximal end, a distal end and a longitudinal axis between the distal end and the proximal end;

moving the flexible probe in the body and placing the ultrasonic probe in communication with the biological material; and

activating an ultrasonic energy source of the ultrasonic medical device to produce an electric signal that drives a transducer of the ultrasonic medical device to produce a torsional vibration along a portion of the longitudinal axis of the flexible probe.

56. The method of claim 55 wherein the torsional vibration induces a transverse vibration along the longitudinal axis of the flexible probe.

57. The method of claim 55 further comprising applying a tension to the flexible probe causing the transverse vibration to tune into coincidence with the torsional vibration.

58. The method of claim 55 further comprising bending the flexible probe causing the transverse vibration to tune into coincidence with the torsional vibration.

59. The method of claim 55 further comprising superimposing the torsional vibration and the transverse vibration over the longitudinal axis of the flexible probe.

60. The method of claim 55 further comprising segregating the torsional vibration and the transverse vibration over the longitudinal axis of the flexible probe.

61. The method of claim 55 further comprising generating acoustic energy in a medium surrounding the ultrasonic probe through an interaction of a surface of the ultrasonic probe and the medium surrounding the ultrasonic probe resulting from the torsional vibration and a transverse vibration.

62. An ultrasonic probe comprising:

a proximal end;

a distal end that terminates in a probe tip; and

a longitudinal axis between the proximal end and the distal end, wherein the ultrasonic probe supports a torsional vibration and a transverse vibration.

63. The ultrasonic probe of claim 62 wherein the ultrasonic probe comprises a substantially uniform cross section from the proximal end of the ultrasonic probe to the distal end of the ultrasonic probe.

64. The ultrasonic probe of claim 62 wherein the ultrasonic probe comprises a varying cross section from the proximal end of the ultrasonic probe to the distal end of the ultrasonic probe.

65. The ultrasonic probe of claim 62 wherein a cross section of the ultrasonic probe is approximately circular.

66. The ultrasonic probe of claim 62 wherein the ultrasonic probe comprises a substantially uniform diameter from the proximal end of the ultrasonic probe to the distal end of the ultrasonic probe.

67. The ultrasonic probe of claim 62 wherein the ultrasonic probe comprises a varying diameter from the proximal end of the ultrasonic probe to the distal end of the ultrasonic probe.

68. The ultrasonic probe of claim 62 wherein the ultrasonic probe comprises a radially asymmetric cross section at the distal end of the ultrasonic probe.

69. The ultrasonic probe of claim 62 wherein a diameter of the ultrasonic probe decreases from the proximal end to the distal end.

70. The ultrasonic probe of claim 62 wherein one or more diameter transitions gradually taper the diameter from the proximal end of the ultrasonic probe to the distal end of the ultrasonic probe.

71. The ultrasonic probe of claim 62 wherein one or more diameter transitions are stepwise to change the diameter from the proximal end of the ultrasonic probe to the distal end of the ultrasonic probe.

72. The ultrasonic probe of claim 62 wherein the ultrasonic probe has a flexibility allowing the ultrasonic probe to be deflected and articulated.

73. The ultrasonic probe of claim 62 wherein the ultrasonic probe is disposable.

74. The ultrasonic probe of claim 62 wherein the ultrasonic probe is for a single use on a single patient.